REPORT OF EXPERIMENT ON THE VALUE OF PLAYS AND GAMES IN ARITHMETICAL DRILL[1]

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The experiment which is reported in this paper was conducted by a student teacher and extended over a period of nine weeks. The grade was the Fourth "A." At the beginning of the work there were twenty children in the class. Soon after, six more entered, giving a total of twenty-six in the end. However, none of the data in this report, with the exception of the statement of the training-teacher, was taken before the entrance of the last six pupils.

The aim of this experiment was (1) to prove that more ground may be covered than is required by our course of study, (2) to determine the effects of plays and games in arithmetical drill.

The following is the statement of the teacher in whose room the experiment was conducted, as to the condition of the class at the time the work began and her general criticism of the work as conducted.

At the beginning of the last nine weeks the children knew their multiplication tables and the first case in long division. At the end of the eighth week they had completed long division and had started fractions as far as addition.

During this period all the children took an active part in the arithmetic games, which were carefully and skilfully carried out by the teacher in charge. The interest was keen and the children worked hard and cheerfully when a game was in view.

The period following was a period of relaxation. This was necessary in order to have the children ready for further work. I believe the arithmetic games are an excellent motive to interest children in arithmetic and to make the work seem alive to them. An increased efficiency in word problems was noticeable.

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[1] This experiment was outlined and supervised by Myrtie Collier, teacher of mathematics in the Los Angeles State Normal School.

The ground covered was the last half of Case 1 in long division, through long division to the addition of fractions. This was done in the time allowed by the course of study to drill in long division. During this period considerable work in word problems was taken up which was almost entirely a review and application of simple operations in the fundamental processes. When this work began, the class was doing long division problems in which the division was of two numbers, the first being greater than the second. At the close of the term they were able to handle any divisor consisting of two or three integers and seemed much more capable of handling word problems than formerly. In advance of this, which was the regular work for the Fourth Grade, they had acquired a good concept of fractions, were able to add fractions having the same denominator, and to multiply a whole number by a fraction.

The part of interest lies in the "how," rather than the "what," however, for the latter will vary according to the grade and locality in which one teaches. The work was accomplished by the use of plays and games with formal drill. In the nine weeks games were used seven times, which does not include two smaller play devices used in the more formal periods of drill.

The games were (1) the baseball game, (2) the "Santa Monica" Road Race, and (3) the "Grand Avenue Department Store." The play devices were a clock face with movable hands, for each child, and a card game. A description of the games follows.

<div align="center">BASEBALL</div>

Preparation for the game.—

1. Selection and making two copies of problems, one for the pitcher, other for the umpire (teacher).

2. Choosing of team and team names by the children.

Scheme of game.—

Captains compete on problems to decide which team has first "bats." The first correctly finished wins "bats" for his team. Captains choose at signal, "Play ball." The successful captain then works on paper, competing with the batter at board, who is also competing with the catcher. If the batter is the first one

finished and correct, he passes on to "first," where he competes with the first baseman and the right fielder at the same time that another of his team is working at bats. If the batter is the first one finished and correct, he passes on to "first," where he competes with the first baseman and the right fielder at the same time that
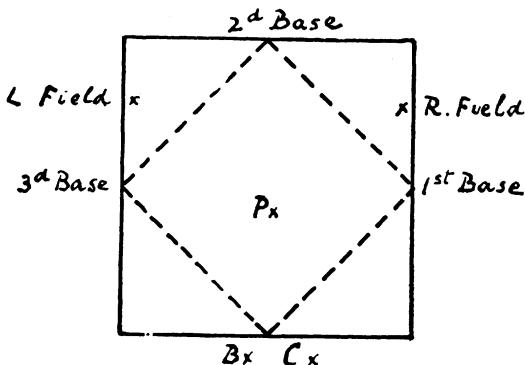
another of his team is working at bats. If the batter is not the first one finished and correct, he has been put out. Three outs means change of team at bats and two changes make an inning. A "run" consists of a player having successfully passed the third base and counts 1 for his team.

COMPARATIVE TABLE

Table of Baseball   *Formal Drill*

(NUMBER OF PROBLEMS)

Problem worked in game:
First game = 7   Average = $8\frac{2}{3}$ problems per game
Second game = 9
Third game = 10
Problems in formal drill   Average = $4\frac{2}{3}$ per day

This means, of course, that $8\frac{2}{3}$ problems were correctly worked by *different* pupils, during the game, those who were running for their team, as opposed to an average of $4\frac{2}{3}$ for each child during the formal drill. However, by the time of the third game all the children were working all the problems, which gave each child ten problems during that hour.

ROAD RACE

Preparation: 1. Teacher.—

1. Selection of problems.

2. Selection of familiar names for stations.

3. Writing of problems on board (one or two) under name of each station.

4. Working of problems before class so that *all* the answers may be had at once.

5 (desirable but not necessary). Making of pennants, one for each child, a different color for each machine, each pennant bearing initial of his machine and his individual number. These are quickly and easily made from any art paper at hand.

Preparation: 2. Pupils.—

1. Choice of names for machines (one for each row).

2. Numbering down rows for individual machine's number.

Scheme of game.—

One of *each* kind of *machine* starts at *each* station. Work on paper. Take problems from board. As soon as anyone is finished he goes to the teacher who tells him if he is correct; if he is, he goes on to the next station to the right; if not, he goes back and works that problem over again. When he does get right he goes immediately to work on his new problem at the next station, and another machine of his same make takes his place at the old station. In this way the whole class is soon on the floor and at work. The score is made by the number of players on each side who complete the circuit, the machine having had the greatest number being accounted the winner.

When the game starts one will have as many as eighteen on the floor starting to work and inside of five minutes will be able to put on ten more, for the work in this game is very rapid. This is in the teacher's opinion the best way of keeping *every* child working *every* minute.

COMPARATIVE TABLE

Road Race v. Formal Drill

	Road Race	Formal Drill
Average No. problems correct	$4\frac{9}{13}$	$3\frac{25}{26}$
" " " incorrect	$1\frac{4}{13}$	$\frac{19}{26}$
" " " worked	$6\frac{1}{13}$	$4\frac{9}{13}$

It is shown here that the number of problems worked in the road race was greater, and that the number worked correctly was greater than on the day of the formal drill and that despite the fact that the degree of inaccuracy is greater on the day of the game. This inaccuracy is due, I believe, wholly to the fact that the children had not yet accustomed themselves to the excitement. The only criticism that might be offered here is that things move so rapidly that the teacher has no chance to give any individual help. Still, that also has its advantage, for it gives the child the chance to find his own mistakes and profit by them.

<div align="center">STORE</div>

Preparation.—

1. To decide kind of store—grocery or department.

2. To have children bring things.

3. To have children make invoice, prepare store, and help them determine prices.

4. To prepare lists for the class's first trip to store.

5. To select clerks, bookkeepers, head bookkeeper, have children make signs, play money, and price lists for their customers. The latter are put on the board.

Scheme of game.—

Clerk makes sale, writes slip and duplicate. Slip goes to buyer and duplicate to bookkeeper who makes change and O.K.'s the slip. Buyers go in relays. When through making purchases or when told to take seat, buyers go "home," make out a statement of money on hand when game started, purchases made, total amount spent, money on hand at present. This shows whether they have accepted wrong change and if the clerks are making wrong change. They then figure out where the mistake was made and go back to that department and state their case. At the end of about twenty minutes' buying the store closes, the clerks begin putting away the goods, while the bookkeeper checks up his slips. He makes out a statement which he hands in to the head bookkeeper with his cash drawer, showing money in drawer at beginning of hour, sales made and amount, money in drawer at close of period. His account must balance. This is determined by the head bookkeeper, who

makes out the report of the store by departments and hands it into the manager (teacher). All reports go to the teacher.

This game is particularly valuable in teaching how to make a sales slip, beginning of bookkeeping, denominate numbers, i.e., money, linear measure, weights and values, practical fractions, etc.

To be able to tell the effect of this game one should use it for about a week at first, then omit it for six or seven lessons and repeat it. It was impossible to do this at this time, for the end of the year was at hand, so it was used on only two successive days. On both days the work went very well, but especially so on the second day. The storekeepers had learned to make the change for $12\frac{1}{2}$ cents or any sum with half-cents, on the first day, and the board price lists showed many articles on special sale at $7\frac{1}{2}$ cents, $12\frac{1}{2}$ cents, $87\frac{1}{2}$ cents, etc. As a whole the work was accurate and it was decidedly a success.

Probably the most noticeable effect of these games was the joy the children gained from the games which they carried over into the formal drills. They seemed to feel that since the games were "fun," all number work was, and they worked with a will. There was never a day after a game that I found the discipline at all difficult and never a game where the children seemed inclined to take advantage of their freedom. And they were *free*, they laughed and ran to their bases or stations, and jumped and clapped when their team or machine scored. There was nothing stiff or formal about the work.

The fact that the class went farther than the work assigned by the course of study, in even such a short time as was allowed for this work, proves the first point stated in the aim. In the second place, it is shown that *more work* and that *more accurate work* is accomplished through the use of plays and games as drill devices than by the ordinary methods of formal drill.